Aug. 28, 1928. 1,682,049

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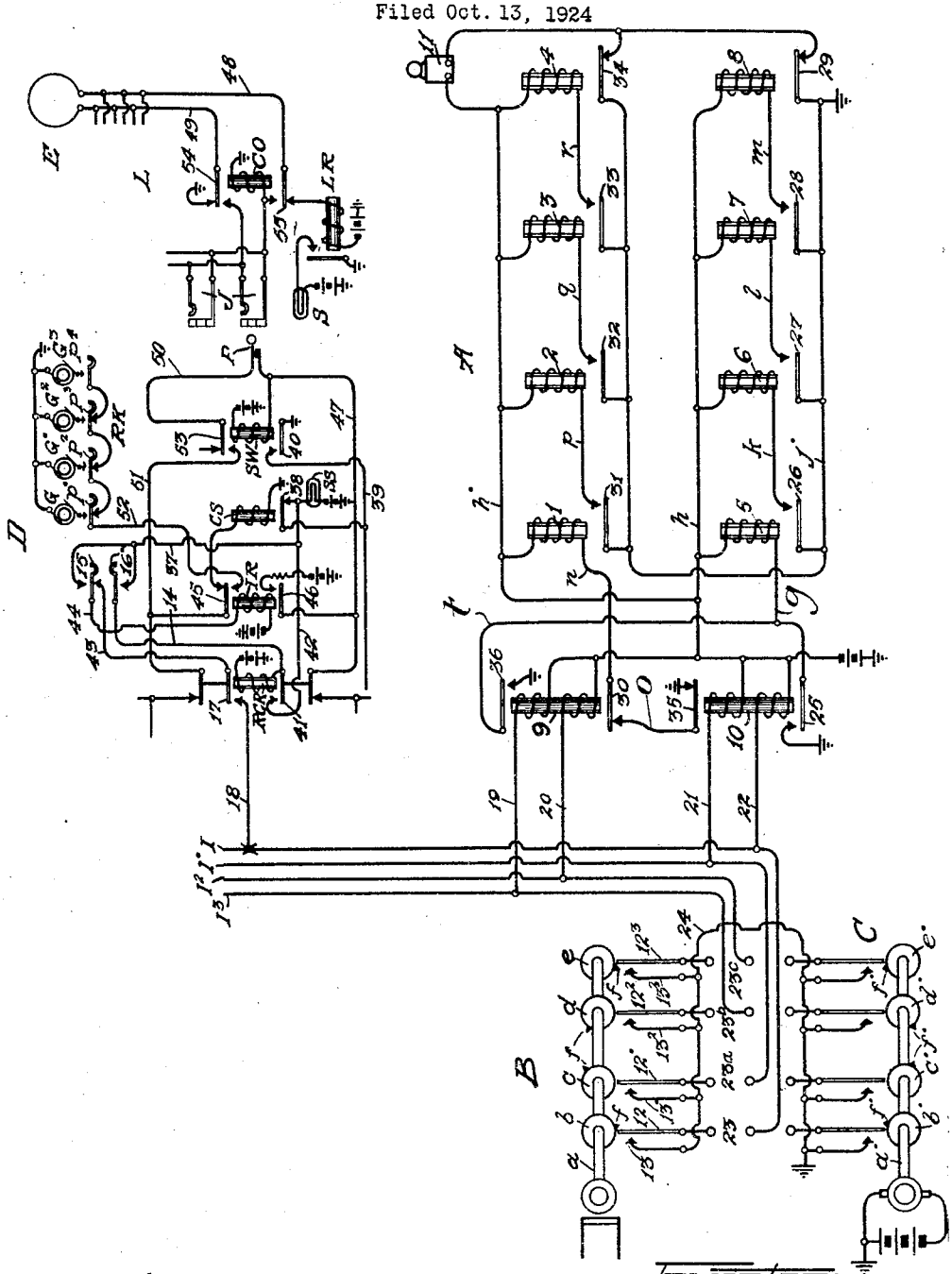
ALARM CIRCUIT

Filed Oct. 13, 1924



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Patented Aug. 28, 1928. 1,682,049

UNITED STATES PATENT OFFICE.

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ALARM CIRCUIT.

Application filed October 13, 1924. Serial No. 743,237.

My invention relates to ringing interrupters, such as are commonly used in connection with ringing and signaling means in telephone exchange systems. In telephone systems of the class in which so-called automatic or machine ringing is employed, duplicate ringing interrupters are employed, one which may be termed the primary ringing interrupter, which is motor-driven. The current for operating the motor is usually supplied from a 110 volt circuit received from an outside source, such as the town or city electric power plant. The other ringing interrupter is also motor-driven and the current for operating the motor is supplied by current received from an exchange storage battery. In many instances the source of current operating the motor for rotating the interrupter mechanism of the primary interrupter is shut off, which makes it necessary to employ the emergency ringing interrupter, and in order to connect the storage battery with the motor for rotating the emergency interrupter mechanism, the operator presses a button which is located on the switchboard and under her control, or a switch, which is located on the power board.

In many cases the operator is unaware of the stopping of the interrupter mechanism, and my invention is a means of giving an immediate alarm when either the primary interrupter or the emergency interrupter fails to function properly, stopping on either an open or a closed contact, or when any of the interrupter leads become grounded for any reason whatsoever.

In the accompanying drawing the preferred form of my invention is shown at A. It consists of eight slow-acting relays, namely, relays 1 to 8, inclusive, and two quick-acting relays, namely, relays 9 and 10, and a suitable alarm device 11.

At B is shown the primary ringing interrupter consisting of a shaft *a* revolving at a predetermined speed. To the rotatable shaft of the primary ringing interrupter are secured disks, *b*, *c*, *d* and *e*, each of which is provided with a cam surface *f*, the purpose of which is to close contacts for completing interrupter circuits.

At C is the emergency ringing interrupter composed of a rotating shaft *a'* to which are secured disks *b'*, *c'*, *d'* and *e'*, each disk having a cam *f'*, the purpose of which is to close contacts for completing interrupter circuits.

To further illustrate my invention I have shown a portion of a cord circuit D, for connecting the ringing current controlled by the ringing interrupters B and C with a subscriber's station E. The cord circuit D is designed for automatic ringing, and I have shown the ringing interrupters B and C in position to be operated therewith. The cord circuit consists of a calling plug P, a calling supervisory relay CS, a supervisory lamp SS and the apparatus necessary for automatic ringing. This consists of a party-line ringing key RK, four ringing generators G, G', G^2 and G^3, a ringing control relay RCR, an interrupter relay IR, and a switch relay SW.

The subscriber's station E terminates in a line circuit L, which consists of a line relay LR, a cut-off relay CO, a line signal S, and multiple jacks J.

The motor driven ringing interrupters are connected by means of double-throw knife switches 23, 23^a, 23^b and 23^c, to the interrupter leads I, I', I^2 and I^3, which are distributed to the different cord circuits in the different operators' positions in the exchange.

The following is a description of the action of my invention in connection with the ringing interrupters B and C. The action is the same in both cases, that is, if the primary ringing interrupter B is connected to the interrupter leads by means of the double-throw knife switches, the action of A and D will be the same as it would be if the emergency ringing interrupter C was connected to the interrupter leads by means of the double-throw knife switches.

For purposes of illustration, we will assume that the primary ringing interrupter B is in operation. I will describe the action of disk *b*, the action of disks *c*, *d* and *e* being similar to that of disk *b*. When the cam *f* engages with spring contact 12, it presses contact 12 into engagement with contact 13 which energizes the ringing interrupter relay in the cord circuit D, in the usual manner, and also energizes relay 10 in A by current flowing from battery through the lower winding of relay 10, conductor 22, interrupter lead I, through switch 23, spring contact 12 contact 13 and conductor 24 to ground. This circuit will remain closed as long as cam *f* on disk *b* is riding over and pressing spring contact 12 into engagement with contact 13, or it will remain closed when cam *f* on disk *c* is riding over and pressing spring contact 12' into

engagement with contact 13'. Therefore, relay 10 is energized whenever cams *f* on disks *b* or *c* are pressing spring contacts 12 or 12' into engagement with contacts 13 or 13', and relay 9 is energized whenever cams *f* on disks *d* or *e* are pressing spring contacts 12^2 or 12^3 into engagement with contacts 13^2 or 13^3. Relay 9 has the same effect as relay 10 on the slow-acting relays, namely relays 1 to 8, inclusive, all of which may be readily understood by one skilled in the art.

When the ringing interrupter B is in operation, the alarm signal 11, will not be operated because of the following action: When rotating shaft *a* revolves, cam *f* on disk *b* presses spring contact 12 into engagement with contact 13, this action energizes relay 10, setting up a circuit as before described. When relay 10 is energized, it attracts armature 25 which energizes relay 5 by means of current flowing from battery through conductor *h*, relay 5, conductor *g*, alternate contact 25 of relay 10 to ground. The actuation of relay 9 has the same effect on relay 5, as has the actuation of relay 10, because when relay 9 is actuated it establishes a circuit for the energization of relay 5 by current flowing from battery through conductor *h*, relay 5, conductors *g* and *t* to ground at alternate contact 36 of relay 9. The actuation of relay 5 energizes relay 6 by the establishment of a circuit in this manner, current flowing from battery, through conductor *h*, relay 6, conductor *k*, alternate contact 26, which was attracted when relay 5 was energized and conductor *j* to ground. By this action relay 7 is actuated by current flowing from battery through conductor *h*, relay 7, conductor *l*, alternate contact 27, and conductor *j* to ground. Relay 8 is actuated and attracts its armature, by current flowing from battery through conductor *h*, relay 8, conductor *m*, alternate contact 28, and conductor *j* to ground.

When relay 8 attracts its armature 29, ground is removed from the circuit of the alarm device, shown in the accompanying drawing in the form of a bell 11. This prevents the bell from ringing, provided relay 4 is actuated and its armature 34 is attracted. Cam *f*, on disk *b*, presses spring contact 12 into engagement with contact 13 for one second and releases it for four seconds. When cam *f* on disk B passes spring contact 12, the circuit for the energization of relay 10 is broken and relay 10 is de-energized, thus releasing its armatures 25 and 35, allowing them to resume their normal positions as shown in the drawing. When armature 35 is released and returned to its normal position a circuit for the energization of relay 1 is completed by current flowing from battery through conductor *h'*, relay 1, conductor *n*, normal contact 30, conductor *o*, and normal contact 35 to ground. As relay 1 is actuated its armature 31 is attracted and a circuit is closed through relay 2 by current flowing from battery through conductor *h'*, relay 2, conductor *p*, alternate contact 31 and conductor *j* to ground. Relay 2 is thus energized and closes a circuit for relay 3, current flowing from battery through conductor *h'*, relay 3, conductor *q*, alternate contact 32, and conductor *j* to ground. When relay 3 is actuated, it sets up a circuit for the energization of relay 4 over a path traced from battery through conductor *h'*, relay 4, conductor *r*, alternate contact 33 and conductor *j* to ground. When relay 4 is actuated its armature 34 is attracted to its alternate position and the bell 11 does not ring because both armature 29 of relay 8 and armature 34 of relay 4, are in their alternate positions, and the ground for the completion of a circuit through the alarm device must come through either armature 29 when it is in its normal position, or through armature 34 when it is in its normal position.

When relay 10 was de-energized armature 25 returned to its normal position, thus breaking the circuit for the energization of relay 5 by removing ground. Relay 5, being a slow-acting relay, does not release its armature immediately, but hesitates for a fraction of a second. When it does release, its armature 26, the armature returns to its normal position, thus breaking the circuit for the energization of relay 6. Relay 6, when de-energized, releases its armature 27 which breaks the circuit for the energization of relay 7. When relay 7 releases its armature 28, the circuit for the energization of relay 8 is broken. Before it can release its armature, due to the delay caused by the slow-action of relays 5, 6 and 7, a new circuit for the energization of the relays has been set up by the next disk on the rotating shaft of the ringing interrupter pressing spring contact 12' into engagement with contact 13'. Each succeeding disk on the rotatable shaft of the ringing interrupter sets up a circuit in the relays and thus the relays 4 and 8 are constantly energized and their armatures attracted as long as the ringing interrupter is working.

It will be noted that the energizing circuits for the lower group of slow-acting relays including relays 5, 6, 7 and 8 are controlled by the make contacts 25 and 36 of relays 10 and 9 respectively, while the energization circuit of the upper group of relays including relays 1, 2, 3 and 4 are controlled by the back contacts 35 and 30 of relays 10 and 9 respectively. Relay 10 is energized each time disks *b* and *c* close their contacts while relay 9 is energized each time disks *d* and *e* close their associated contacts. It will thus be seen that relays 9 and 10 follow the grounding of the interrupter leads I, I'; I^2 and I^3. The slow-acting relays are so timed that when the interrupter machines are operating at their normal

speed the last relays of the series, 4 and 8 do not de-energize to close the alarm circuit before they again have their circuits closed by the preceding slow-acting relays of the series.

I will next describe how an alarm will be given if the ringing interrupter stops working when on an open circuit. If the ringing interrupter stops on an open circuit none of the cams *f*, on the disks *b*, *c*, *d* and *e*, will be pressing spring contacts 12, 12′, 12² and 12³, and consequently there will not be a ground connection on any of the interrupter leads I, I′, I² and I³. If the interrupter leads I, I′, I² and I³ have no ground connection, relays 9 and 10 cannot be energized, and if relays 9 and 10 cannot be energized, relays 5, 6, 7 and 8 will be de-energized, thus allowing armature 29 of relay 8 to resume its normal position which will set up a circuit in the alarm device 11, by current flowing from battery through conductor *h′*, bell 11, conductor *s*, and alternate contact 29 to ground. When the bell 11 is operated, an alarm is given informing the operator that the ringing interrupter in use has stopped working.

I will next give a description of the action when the ringing interrupter stops on a closed contact. I will say for an illustration that the ringing interrupter stops when cam *f* on disk *b* is pressing spring contact 12 into engagement with contact 13, thus energizing relay 10 by establishing a circuit as follows: battery through relay 10, conductor 22, interrupter lead I, switch 23, spring contact 12, contact 13 and conductor 24 to ground. When relay 10 is energized, it attracts the armature 35 which breaks the circuit for energizing relay 1 by taking ground off it. When relay 1 is deenergized, it releases the armature 31 which breaks the circuit for energization of relay 2, which in turn breaks the circuit for the energization of relay 3, and the de-energization of relay 3 breaks the circuit for the actuation of relay 4, which returns its armature 34 to its normal position which will cause the bell 11 to operate to give an alarm, current flowing from battery through conductor *h′*, bell 11, conductor *s*, normal contact 34 and conductor *j* to ground, all of which will be understood by one skilled in the art.

If one of the interrupter leads should become permanently grounded either relay 9 or 10 will remain steadily energized in which event one of the series of slow-acting relays will become de-energized and close a circuit for alarm device 11.

It will likewise be noted that if one or more of the interrupter contacts should fail to connect ground to an interrupter lead that the alarm device will be operated. This may occur due to dirty contacts or due to the springs failing to properly contact.

I will next describe the action of the ringing interrupters B and C in conjunction with the cord circuit D, assuming that D is one of the cord circuits to which interrupter lead I is common. Assuming that the operator desires to signal the subscriber at E, she inserts plug P into jack J, closing an energizing circuit for the cut-off relay CO, and switching relay SW, in series, current flowing from battery through the winding of relay SW, sleeve contacts of plug P and jack J, the winding of relay CO to ground. The relay SW closes its alternate contact 40, closing a circuit for the supervisory signal SS which remains lighted until the called subscriber answers. The operator now fully depresses the proper ringing key plunger P′, P², P³ or P⁴, of the party-line ringing key RK, and assuming it is the plunger P′ which is depressed, the end springs 15 and 16 momentarily assume their alternate positions, the spring 16 closing an energizing circuit for the ringing control relay RCR, traced from battery through relay RCR, conductor 14, alternate contact 16, conductor 37, normal contact 38, conductor 39 and alternate contact 40 of relay SW to ground. Although the circuit of relay RCR is interrupted at contact 16, when the operator removes pressure from the actuated plunger, the relay RCR closes a locking circuit for itself, traced from battery through relay RCR, alternate contact 41, conductor 42, normal contact 38, conductor 39 and alternate contact 40 of relay SW to ground.

Upon the energization of relay RCR, its alternate contact 17 is closed, which connects interrupter lead I of the ringing interrupter with the interrupter relay IR of the cord circuit D. Assuming that the cam *f* on disk *b* of the ringing interrupter is pressing spring contact 12 into engagement with contact 13, an energizing circuit for the interrupter relay IR is established, traced from battery through winding of relay IR, conductor 44, normal contact 15, conductor 43, alternate contact 17, conductor 18, and interrupter lead I, switch 23, spring contact 12, contact 13 and conductor 24 to ground. Upon the energization of relay IR it closes its alternate contact 45 which connects ringing current to the called line from the ungrounded pole of the generator G, alternate contact *p′*, conductor 52, alternate contact 45, conductor 51, alternate contact 53, conductor 50, tip contacts of the plug P and jack J, alternate contact 54 of relay CO, conductor 49, through the subscriber's set at E, conductor 48, alternate contact 55, sleeve contacts of jack J and plug P, conductor 47, alternate contact 46, of relay IR to battery and ground. The interrupter relay IR is energized each time the interrupter lead I is connected to ground through action of disk *b* on contacts 12 and 13 of the ringing interrupter, thus connecting ringing current to the wanted line for about one second of time, and allowing a silent interval of about four seconds which are the intervals of

the cam *f* on the disk *b*, engaging and disengaging with spring contact 12 of the ringing interrupter.

When the called subscriber answers an energizing circuit for relay CS is set up, traced from ground through relay CS, normal contact 45, which was released when ground was taken off interrupter lead I, as was explained previously, through conductor 51, alternate contact 53 of relay SW, conductor 50, tip contacts of plug P and jack J, alternate contact 54 of relay CO, conductor 49, subscriber's set E, conductor 48, alternate contact 55 of relay CO, sleeve contact of jack J and plug P, and winding of relay SW, to battery. When the relay CS is energized its normal contact 38 is opened, this breaks the locking circuit for relay RCR, which de-energizes and opens the circuit of relay IR at its alternate contact 17. The opening of the alternate contact 17 disconnects the lead I which prevents the relay IR from again operating. The opening of alternate contact 38 of relay CS effaces the lamp signal SS. When conversation has been completed, the subscriber again places his receiver on the hook switch and relay CS is de-energized, thus lighting signal SS, whereupon the operator withdraws the plug P from the jack J, restoring the cord and line circuits.

While I have illustrated my invention in connection with a mechanical interrupter and with a cord circuit, I do not wish thereby to be limited to this particular application of my invention, as it may be used for a number of purposes.

Having described my invention what I claim as new and desire to secure by Letters Patent is:

1. An alarm system for ringing interrupters comprising in combination, an alarm, an alarm circuit, means for maintaining the alarm circuit open during the normal operation of the interrupter comprising a train of quick-pick-up-slow-release relays, means whereby the first relay of the train is energized periodically by the interrupter, means whereby the energization of each of the remaining relays is controlled by its preceding relay independently of the interrupter and means whereby the deenergization of the last relay in the train closes the alarm circuit, the number of relays and their period of release being such that the last relay of the train will not be deenergized between successive closures of the circuit of the first relay by the interrupter.

2. An alarm system for ringing interrupters comprising in combination, an alarm and an alarm circuit therefor, means for maintaining the alarm circuit open during normal operation of the interrupter comprising quick acting and a train of slow release relays, means whereby the quick acting relays are actuated by the interrupter, means whereby the quick acting relays control the energization of the train of slow release relays, and means whereby the deenergization of the last relay in the said train of relays closes the said alarm circuit.

3. An alarm system for ringing interrupters comprising in combination, an alarm and an alarm circuit therefor, means for controlling the alarm circuit including a series of relays, means whereby the first of the series of relays is controlled periodically by the interrupter, means whereby the energization of each of the remaining relays is controlled by its preceding relay independently of the interrupter, means whereby the normal operation of the relays by the interrupter maintain the said alarm circuit open, and means whereby if the interrupter fails to operate the relays of said train of relays the said alarm circuit is closed and the said alarm is operated.

4. An alarm system for ringing interrupters comprising in combination, an alarm and an alarm circuit therefor, means for controlling the alarm circuit including a series of relays, means whereby the first of the series of relays are controlled periodically by the interrupter and the energization of each of the remaining relays is controlled by its preceding relay independently of the interrupter, means whereby the normal operation of the relays by the interrupter maintain the said alarm circuit open, and means whereby if the interrupter maintains the relays of said series of relays operated said alarm circuit will be closed.

5. An alarm system for ringing interrupters comprising in combination, an alarm, an alarm circuit, means for maintaining the alarm circuit open during the normal operation of the interrupter comprising quick and a series of slow acting relays, means whereby the quick acting relays are energized periodically by the interrupter, means whereby the energization of the first slow acting relays is controlled by the said quick acting relays and the energization of each of the remaining relays is controlled by its preceding relay independently of the interrupter, and means whereby an operation of one of the relays of said series closes the alarm circuit, the number of relays of said series of relays and their period of operation being such that the said relay will close the said alarm circuit for an incorrect operation of said interrupter.

Signed by me at Chicago, in the county of Cook, and State of Illinois, this 10th day of October, 1924.

JOHN F. MEYERS.